Modelling forest management within a Global Vegetation Model (ORCHIDEE)

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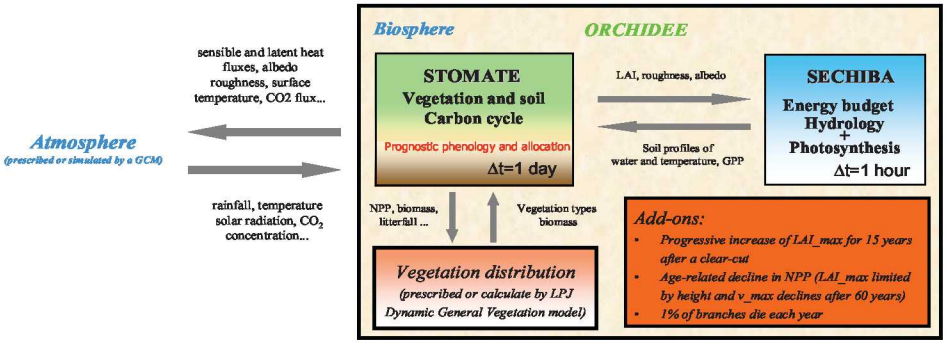
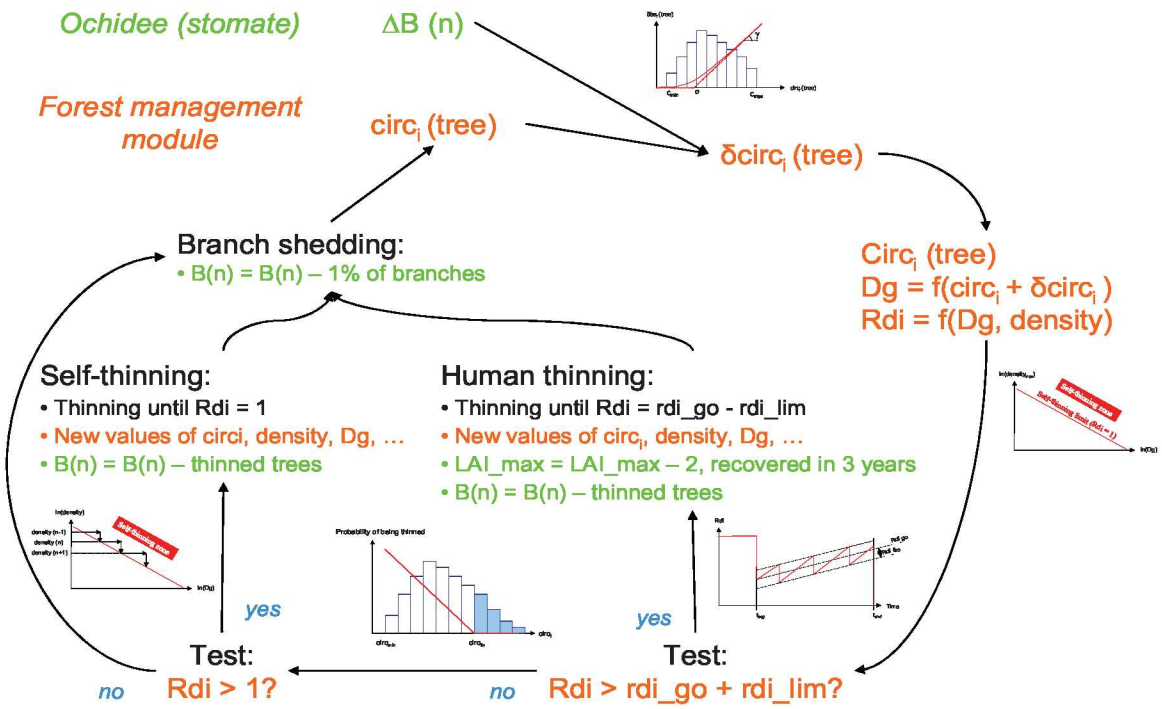
1. Why model forest management within a Global Vegetation Model?

- To improve the predictive power of GVMs
  - ✓Explicit representation of forest stand structure allows the comparison of the model to common field data from forest inventories
  - ✓Shift from the « average tree » representation to the « average stand » will hopefully improve process description, especially at early stages of stand growth, and thus the overall predictive power
- To improve the understanding of the forest sink
  - ✓In recent years, European forests have been estimated to be a net sink of ~140 TgC/yr^{-1} (Lindner *et al.*, 2004). How do « natural » factors (climate change, N deposition) compare to forest management factors (legacy effect of past management, current practices) in explaining this sink?
- To study the interactions between climate change and forest management
  - ✓What is the impact of future climate change on forest productivity? On the structure of forest stands?
  - ✓Does forest management have an impact on climate change?

2. Structure of GVM: ORCHIDEE (Krinner *et al.*, 2005)



3. Structure of forest management module: based on Fagacees (Dhôte, 1999)



4. Sensitivity analysis

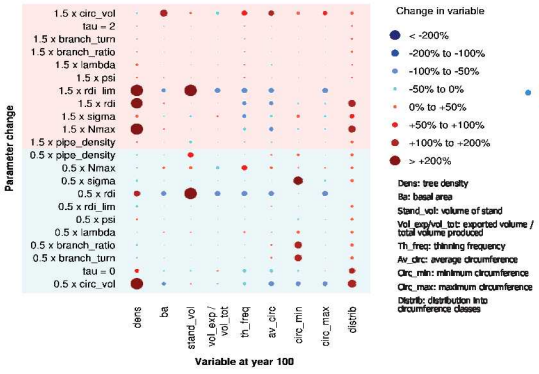
Results of a standard run

	Variable value at year 100
Density (ind.ha^{-1})	56
Basal area (m^2.m^{-2})	28.69
Stand volume (m^3.ha^{-1})	604
Exported volume / Total volume	0.49
Thinning frequency (years)	53
Average circumference (m)	2.97
Minimal circumference (m)	0.82
Maximal circumference (m)	4.22

Standard value of parameters

Parameter name	Parameter value
ψ	0.47
pipe_density	200000
N_max	a/Dg^b
λ	sqrt(2)/Dg_init
	0.01*max(0,3.7*dom_height)-12.7
σ	
rdi_lim	0.05
	τmax*(0.01+0.99*(circ_lim-circ)/(circ_lim-circ_min))
τi	
branch_ratio	0.15
Diameter-Biomass allometry (diam in cm, bimoass in kgMS)	B=a*D^b
branch_turn	0.000109589

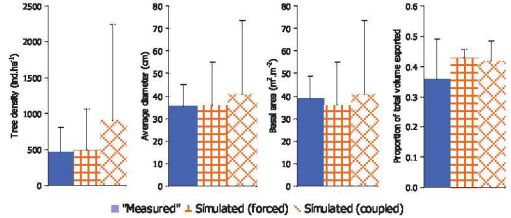
Sensitivity of variables



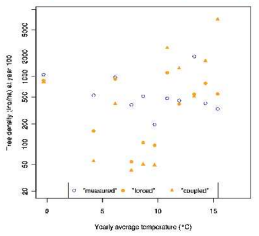
5. Validation against European yield tables

(data source: Teobaldelli M., Federici S., Bellassen V., Seufert G., Pagliari V. (2008).The European Yield Tables Database. URL:http://afoludata.jrc.it/data_fs.cfm)

- 2 sets of simulations
  - ✓« forced » where the forestry module is forced with the productivity given in yield tables
  - ✓« coupled » where the forestry module gets its NPP from ORCHIDEE
- Results
  - ✓The data shows important variability for similar temperatures
  - ✓When « forced », the forestry module is globally consistent with data for tree density and stand volume, with little systematic bias



Comparison between "measured", "forced" and "coupled" on a sample of points



"measured" and "coupled" volume as a function of temperature